Aryan Goyal

Bachelor of Technology in Engineering (**B.Tech**)
Master of Technology in Engineering (**M.Tech**)
Indian Institute of Technology Bombay

Pursuing **Double minor** in **Machine learning & Data Science** and **Digital Health**

Publications and Patents

- **Aryan Goyal**, Ashish Mittal. *"DiffusionXRay: A Diffusion and GAN-Based Approach for Enhancing Digitally Reconstructed Chest Radiographs." Proceedings of the Data Engineering in Medical Imaging (DEMI) Workshop @* ***MICCAI 2025****.*
- **Aryan Goyal**, Shreshtha Singh. *"A Diffusion-Driven Fine-Grained Nodule Synthesis Framework for Enhanced Lung Cancer Detection from Chest Radiographs."* ***(Medical Imaging with Deep Learning — MIDL 2026)***, Submitted
- **Aryan Goyal**, Qure.ai Technologies Private Limited. *"A System and Method for Projecting Synthetic Nodules in Medical Imaging."* ***Indian Patent Application No.: 202521024259*** (Filed)

Professional Experience

Qure.AI | AI Scientist Intern [May '24 - Present]

18+ months contributing to ***lung cancer*** *team working on* ***Diffusion*** *models, resulting in* ***2 publications*** *and a* ***patent***

- Developed synthetic chest X-Ray generation pipelines for training while preserving subtle yet clinically critical features

Uptrain.AI (YC W23) | AI Research Intern [Jan '24 - Apr '24]

Contributed to advancing UpTrain's ***core evaluation platform for custom LLMs****, designing novel subjective metrics*

- Worked closely with the founder to design the subjective metrics, and authored technical blogs on LLM evaluations

UnScript.AI | Deep Learning Engineer Intern [Nov '23 - Dec '23]

Worked on ***Diffusion-based text-to-speech*** *models for Hindi, advancing speech synthesis quality, latency, and accuracy*

- Trained text-to-speech models and achieved effective speaker voice cloning using minimal audio sample data.

Research Projects

LoRA-Enhanced Diffusion Transformer for Multi-Characteristic Chest X-Ray Nodule Synthesis *(Submitted at MIDL 2026)*
Qure.ai, Bengaluru [Summer'25]

Trained LoRA adapters on ***95k*** *chest X-rays with* ***FastDiT*** *backbone for* ***characteristic-controllable*** *nodule synthesis*

- Trained **6 LoRA adapters** atop a frozen **675M-param FastDiT-XL/2** backbone, each adapter controlling one nodule trait—homogeneity, border, calcification, or subtlety—for characteristic-specific nodule inpainting on CXRs
- Introduced a novel **Frobenius-norm orthogonality loss** term to mitigate gradient conflicts when **merging LoRA adapters**, reducing cross-adapter interference by **4.6×** and **outperforming ZipLoRA by 28%**
- Added contrastive subtlety fine-tune, improving radiologist realism scores for low-contrast nodules from **2.7→4.1/5**

Diffusion & GAN-Based Enhancement of Digitally Reconstructed Radiographs *(Published at MICCAI 2025)*
Qure.ai, Bengaluru [Summer'24]

Chest X-Ray ***enhancement/super-resolution****, preserving fine-grained details and radiologist-verified diagnostic gains*

- Built DiffusionXRay, a two-stage pipeline: first **unsupervised style transfer** generated realistic paired high-low-quality X-rays; followed by a **conditional DDPM** trained on these pairs produced final high-quality X-rays.
- Improved PSNR from 20.08 to **27.50** and SSIM from 0.83 to **0.92** on **ChestX-ray8** dataset; radiologists evaluations reported better **subtle nodules preservation and visibility**, critical for diagnostic interpretation and training
- Identified the critical bottleneck in image enhancement and super-resolution: use of unrealistic bicubic-paired training data, then reformulated the problem as a style transfer task and resolved it via novel GAN and DDPM frameworks.

Solid Waste Forecasting and Computer Vision-Based Volume Estimation | Master's Thesis | *[Report]*
Supervisor: Prof. Munish Chandel | IIT Bombay [Autumn '25 - Present]

Developed ***forecasting and computer vision*** *frameworks to predict solid waste generation and estimate pile volumes*

- Performed cross-country correlation and elasticity analysis of solid waste with key socioeconomic indicators and developed a forecasting model for India by adapting China's lagged efficiency trajectory to India's baseline conditions
- Engineered a **2D-image-based volume estimation** system using DINOv3 depth maps in a controlled geometric setup on a conveyor belt, achieved significant cost and scalability advantages over traditional methods such as LiDAR.
- Reported millimetre-level height correction accuracy for volume estimation; forecasting results show strong correlations with income and consumption in China and OECD ($r \approx \mathbf{0.94}$–$\mathbf{0.97}$) and declining solid waste per economic dollar.

MIRA: Multi-Agent Intelligent Reasoning Assistant for Education | Start Up [May '25 - Sept '25]

Agentic AI** platform with **RAG** for curriculum-specific content generation; serving as a **"Cursor for Schools"

- Engineered a scalable **multi-agent framework** for curriculum-aligned lesson content generation, exam creation, and AI-based tutoring, leveraging **RAG and prompt engineering**; developed a **full-stack web application**
- Achieved adoption by **80+ users within 2 months** through deployment of the platform across **two schools**

Online Path-Screened Flow Models for Efficient Hard-Constrained Generation
Supervisor: Prof. Amit Sethi | MeDAL Labs, IIT Bombay [Aug '25 - Present]

Inference-time Flow model framework: hard-constraint satisfaction via adaptive prior sampling and online path screening

- Developed a novel inference-time framework for flow models for satisfaction of hard constraints in generative tasks
- Engineered an adaptive **prior sampling strategy** that preferentially selects from more promising feasible regions for generation, significantly **increasing sample quality and reducing computation costs**
- Developed an evaluation framework employing **early inference checks** for **correction gradients** and **hard constraint** violations, leveraging these for real-time candidate screening for efficient and high-quality generation

Automated Chromosome Segmentation with SAM-2| *[Report]*
Supervisor: Prof. Saket Choudhary | Koita Centre for Digital Health, IIT Bombay [Spring'25]

*Bench-marked and productionised a **SAM-2 based pipeline** that segments metaphase chromosomes **karyotyping***

- Evaluated SAM-2's out-of-the-box performance for automated chromosome segmentation on 2,000 metaphase cell images, achieving **0.678 mAP@0.5** with **42% higher recall** than YOLOv7 without dataset-specific fine-tuning.
- Analyzed segmentation failure modes including overlapping chromosome clustering and redundant mask generation, providing comprehensive insights for robust chromosome boundary detection in challenging cytogenetic scenarios.

Deployment and Training of Tumor Detection Model for TMC Hospital, Mumbai | RnD Project - DH307
Supervisor: Prof. Amit Sethi | MeDAL Labs, IIT Bombay [Spring '23]

*Led the successful deployment of a **cancer/tumor detection model** for **Tata Memorial Hospital, Mumbai***

- Deployment and training of tumor detection model for whole slide images with only **200 high-quality annotated samples**, employing **weakly supervised learning** and data augmentation to achieve deployable performance.
- Developed a **FastAPI-based web application** and **Dockerized model deployment**, enabling clinicians to upload whole slide images and receive real-time, automated tumor predictions

Relevant Coursework

Math & CS	Linear Algebra, Differential Equations, Calculus I, Calculus II, Computer Programming and Utilization, Numerical Methods, Data Analysis & Interpretation
Machine Learning	Advanced Topics in Machine Learning, Machine Learning: Principles and Techniques, Machine Learning for Remote Sensing - II, Programming for Data Science, R&D Project-I (Digital Health), R&D Project II (Digital Health)

Technical Skills

Programming	Python, PyTorch, C, C++, Bash
Areas	Computer Vision, Generative Modeling (Diffusion and Flow models); AI Agents; LLMs

Position of Responsibility

Institute Technical Council | Institute Web and Coding Convener [June'22 - April'23]

*Working in a team of 8 to organise **40+ events** catering to the programming interests of **10K+ students** campus-wide*

- Mentored **juniors from non-CS majors** exploring technology careers, creating beginner-friendly workshops on programming fundamentals, and hosting open-source contribution sessions to build an inclusive tech community.
- Exhibited **self-directed technical learning**, independently acquiring new skills in unfamiliar tech stacks to lead projects from conception to deployment.
- Developed strong **industry collaborations** with companies such as **Marsh McLennan, and Solana**, securing funding and resources for hackathons, technical talks, and hands-on programming sessions, attracting large audiences.

Teaching Assistant

ES-201: Applied Environmental Microbiology and Ecology | Prof. Swantantra Pratap Singh [Autumn '25]

Contributing to course delivery for a class of 50+ students by managing logistics and assisting with evaluation activities.

Scholastic Achievements

- Attained **99.09 percentile** in the JEE Mains 2021 examination amongst **1.18 million** candidates [2021]
- Secured **97 percentile** in **JEE Advanced** 2021 among more than **0.26 million** eligible candidates [2021]
- Scored a total of **327** marks in BITSAT 2021 **(top <1 percentile)** out of **0.3 million** candidates [2021]